

Postharvest Preservation Methods



Evangelos Sfakiotakis
Professor of Pomology

Aristotle University of Thessaloniki





Lecturer: Evangelos Sfakiotakis

Syllabus of the course covered

1. Introduction-

Nature and structure of horticultural commodities

Postharvest losses

Causes of PH losses

Factors involved in deteriorations

Postharvest technology to reduce PH losses

Preservation methods (an overview)

2. The role of ethylene in the PH life

3. Temperature management during the PH life

4. Management the composition of the storage environment (controlled/modified storage)

5. Management the PH physiological disorders

6. Management of PH diseases

The need for reducing postharvest losses by sustainable postharvest handling of fruits and vegetables

Sustainable methods to preserve quality and reduce physiological disorders of fruits and vegetables

Alternative methods to control postharvest diseases

7. Biologically -based technologies

8. Natural volatiles

9. Thermal treatments

10. Modified atmosphere packaging

11. Edible films and coatings

12. Food preservation by hurdle technology

13. PH physiology of fresh-cut horticultural products

14. PH technology of fresh-cut horticultural products



Introduction

Nature and structure of horticultural commodities
Postharvest losses
Causes of PH losses
Factors involved in deteriorations

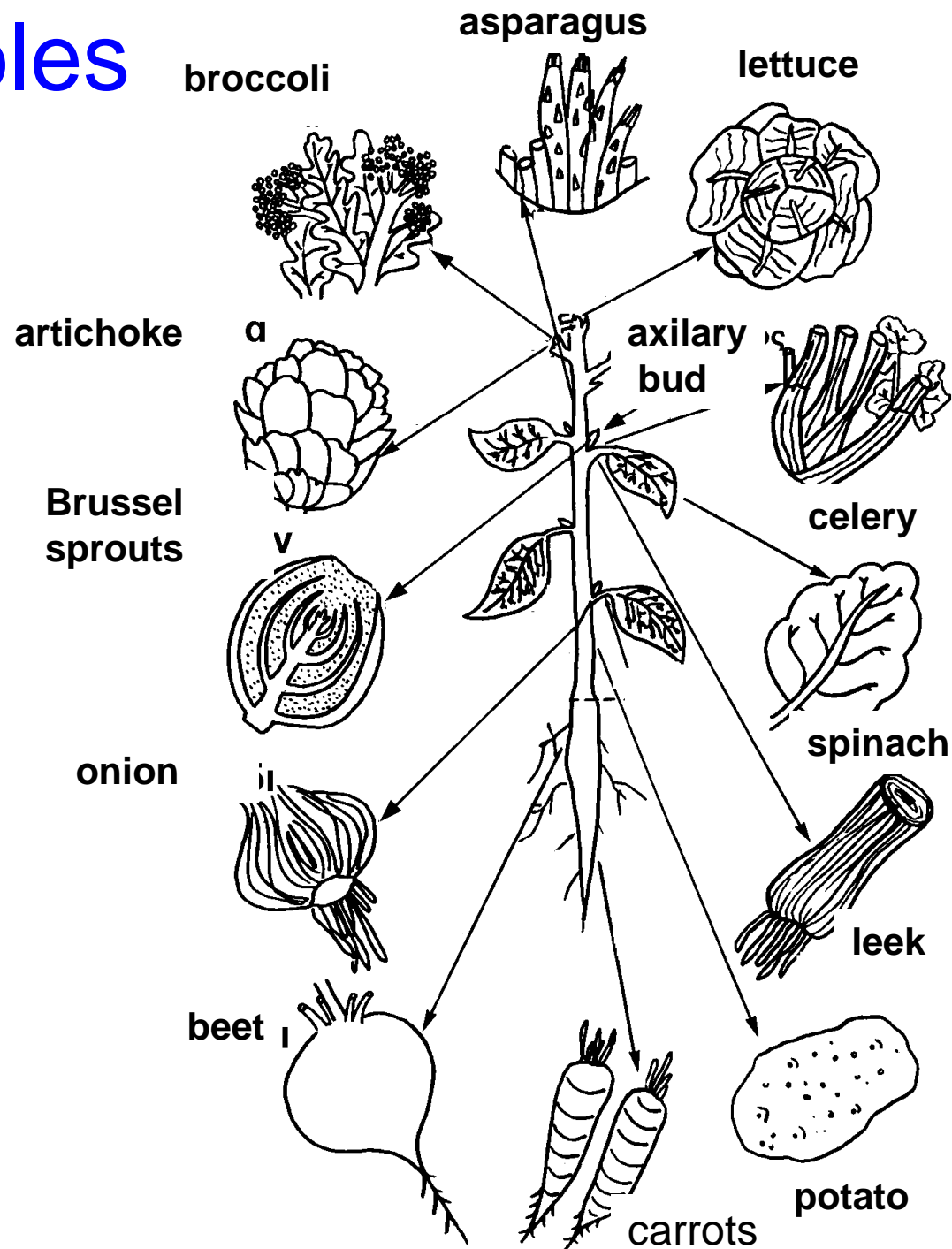
Nature and structure of horticultural commodities

Grouping of harvesting products based on morphology

- Intact plants
- Detached plant parts
- Aboveground structures (leaves, petioles, stems, shoots, flowers, fruits, other structures)
- Leafy vegetables
- Fruits (fleshy fruits, dried fruits)
- Below-ground structures (Roots, tubers)



Vegetables





Leafy vegetables (celery)



leaves

Respiration
transpiration

Leaf blade

petiole

Asparagus

Respiration and transpiration



Flowers (artichoke, broccoli)

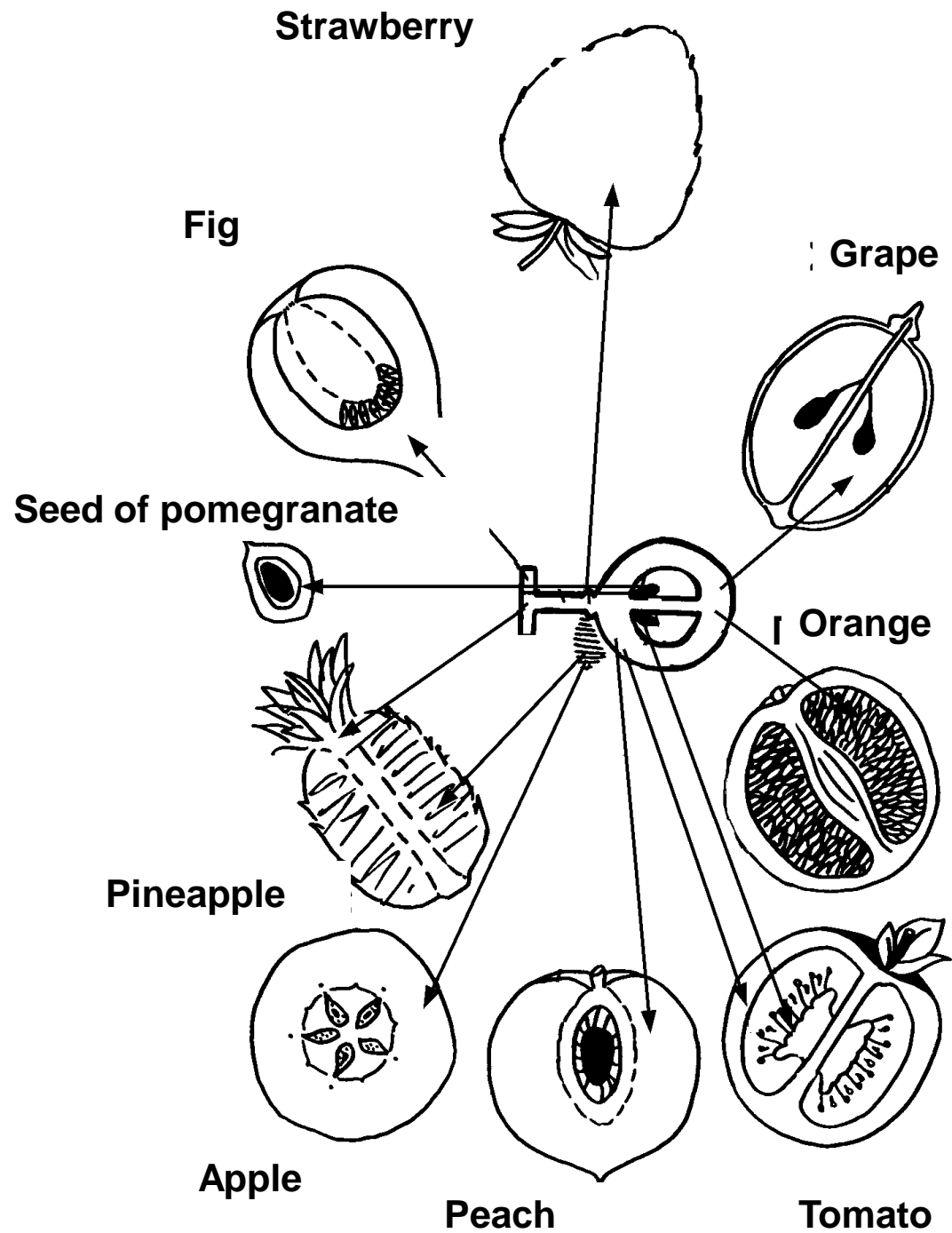


Below-ground structures (Roots, tubers)

Storage of
photosynthase
(starch)



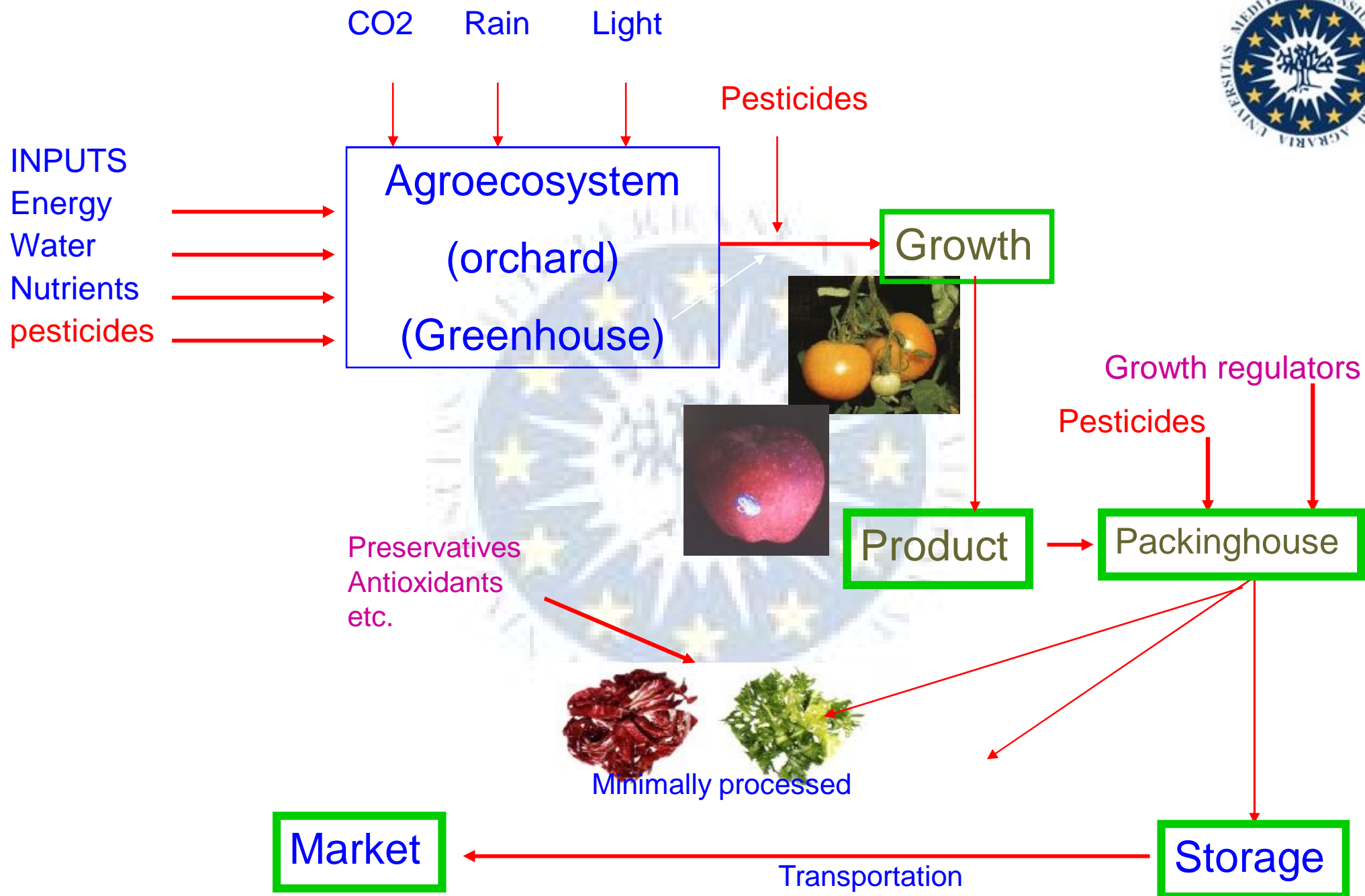
Fruits



Fruits

Fresh fruits (berry, citrus, drupe, apple, fig)







Postharvest losses of fruits and vegetables

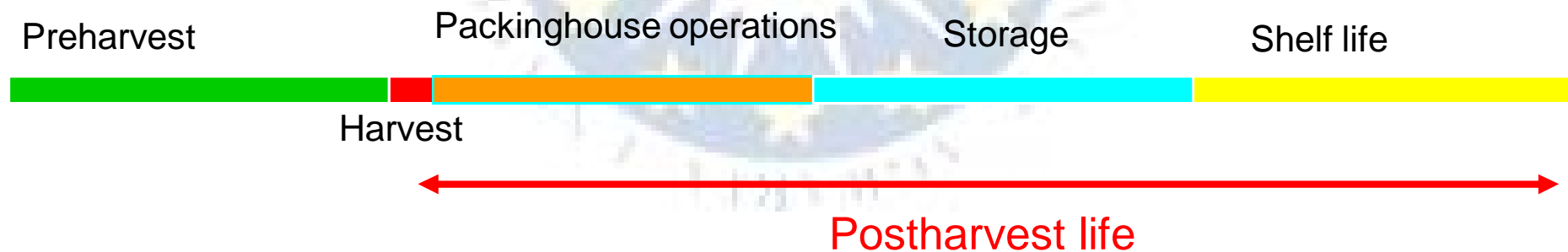
25% in industrialised countries

50% in developing countries

Due to the lack of storage facilities

Perishable products: spoilage from fungal attacks

- high water content
- wounds



Fresh Horticultural products have high rate of deterioration (perishability) during the handling operations from the field to the retail market





CAUSES OF DETERIORATION

- Metabolic changes
- Growth and development
- Mechanical injuries
- Moisture loss (transpiration)
- Physiological breakdown
- Pathological breakdown

Metabolic changes

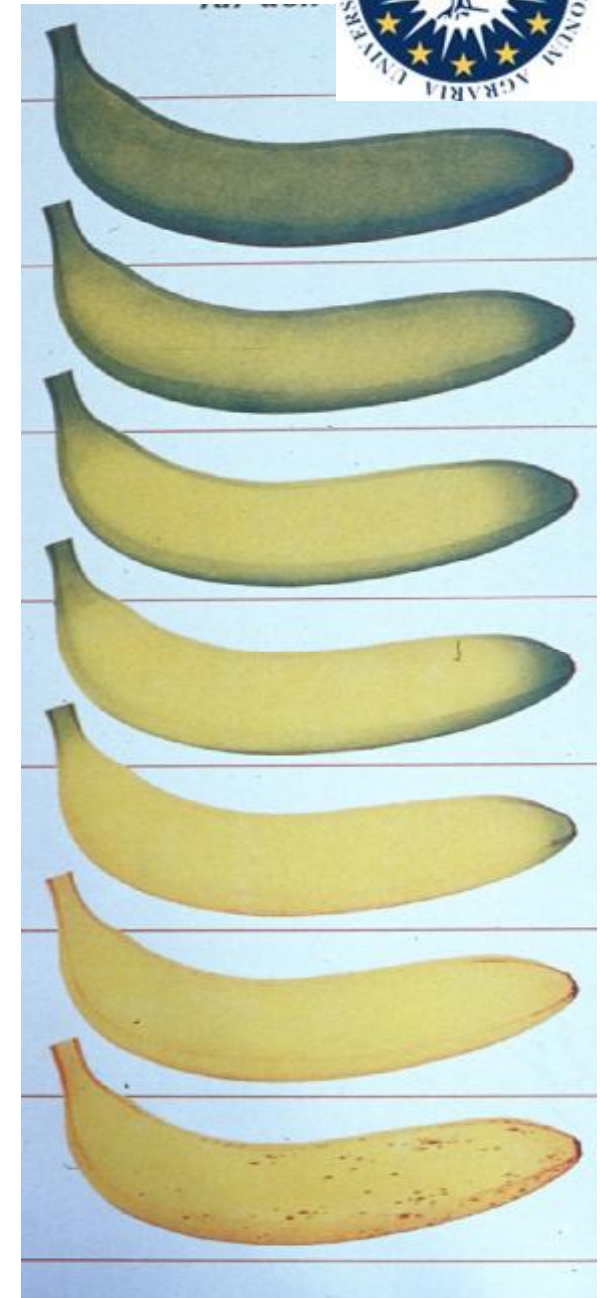
- Loss of chlorophyll
- Development of carotenoids
- Development of anthocyanins (+), (-)

Changes in carbohydrates

starch--> sugar

sugar-->starch

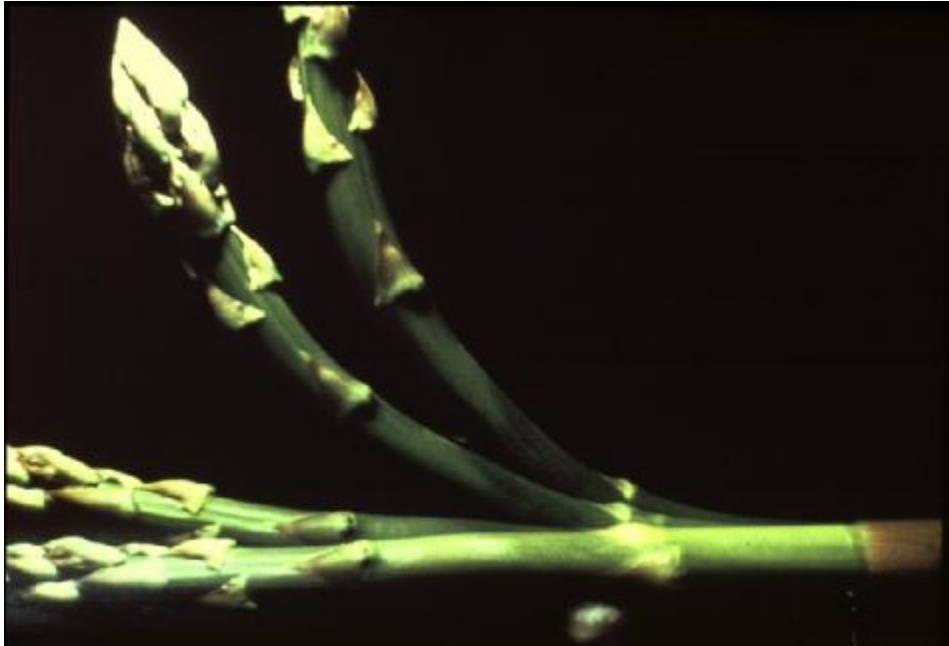
starch-->sugar --> CO₂, H₂O



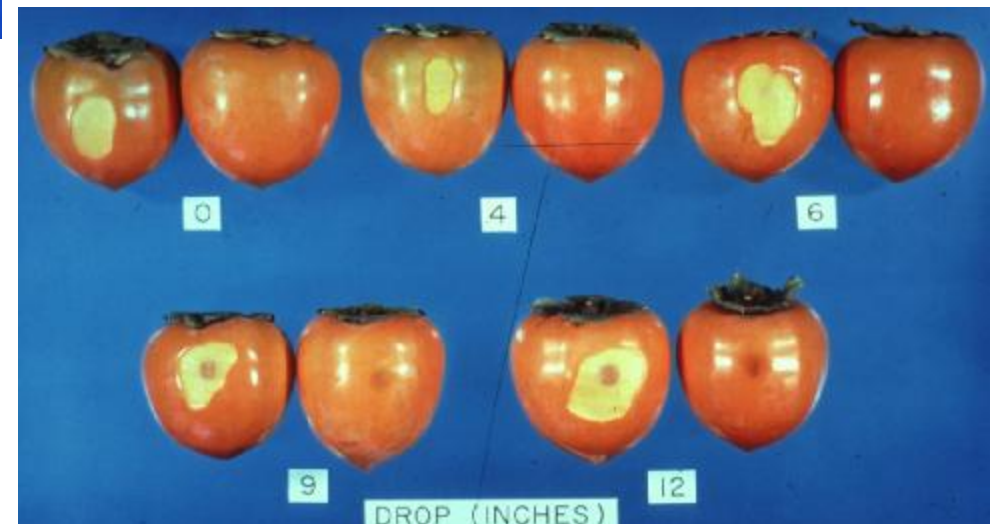
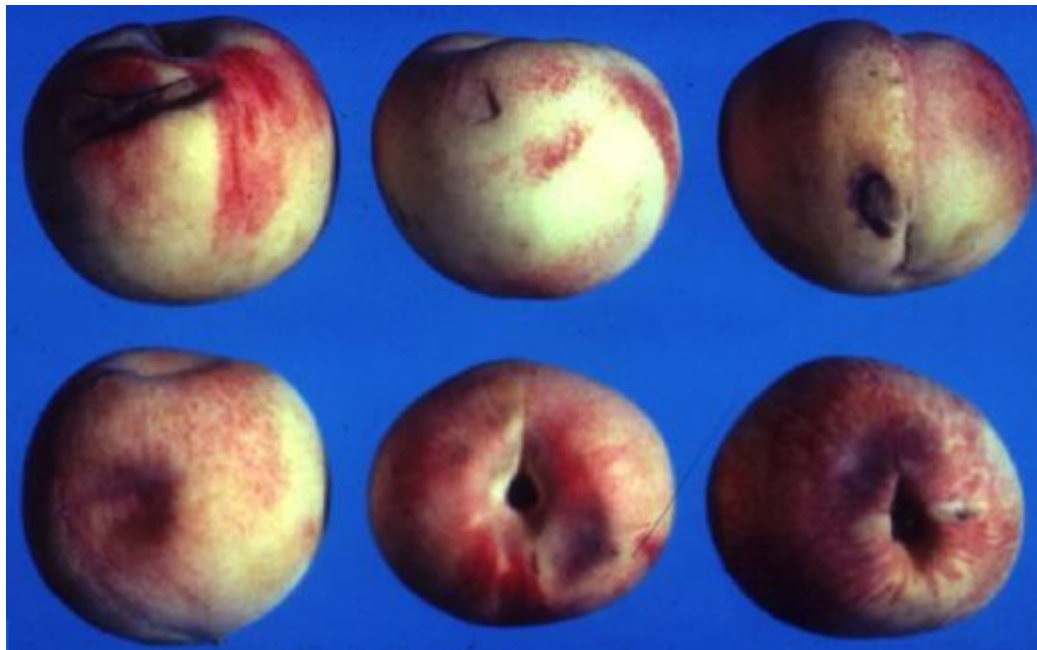
Growth and development



Curvature



Mechanical injuries

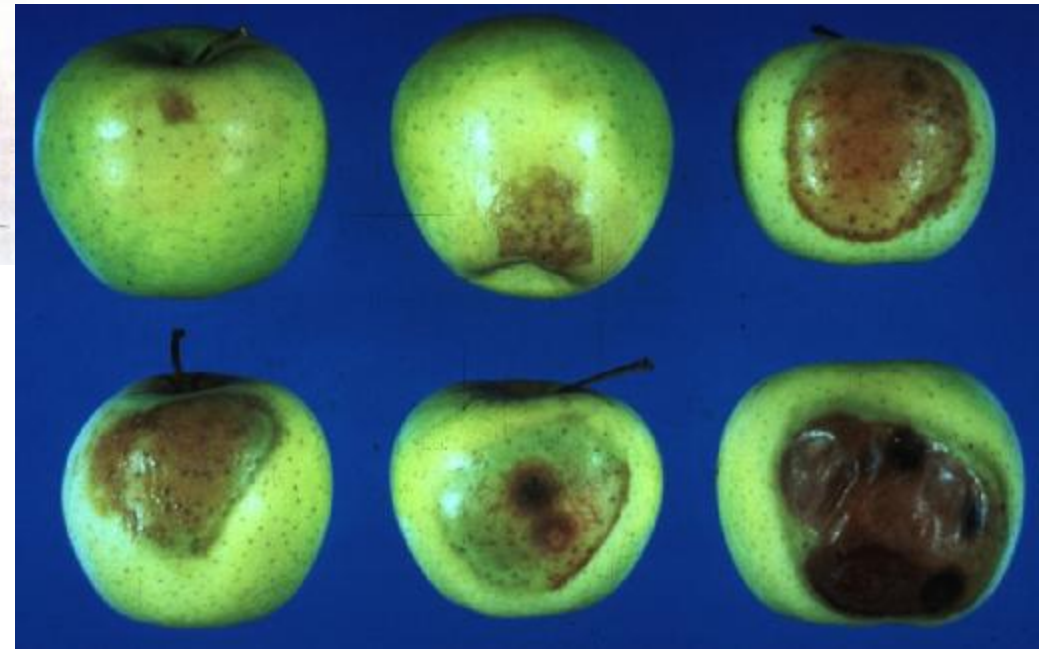


Transpiration



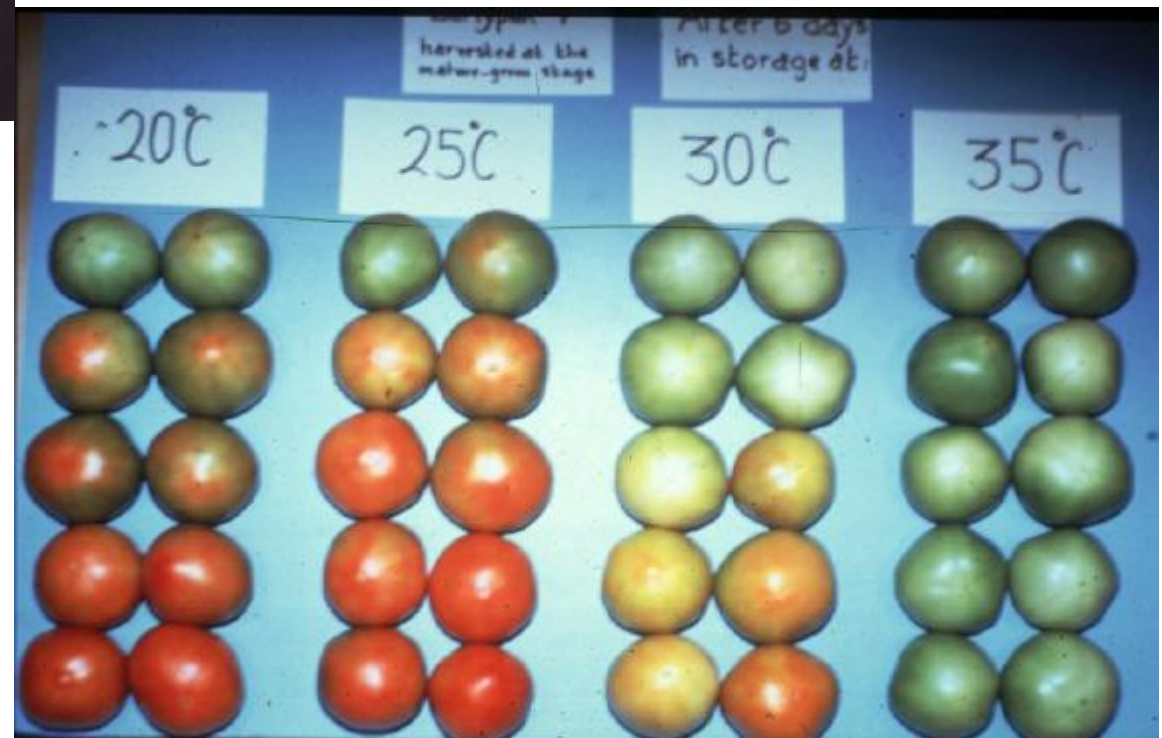
Physiological breakdown

Freezing



Physiological breakdown

Heat damage



Physiological breakdown



Physiological disorders



Low temperature injuries

Pathological breakdown

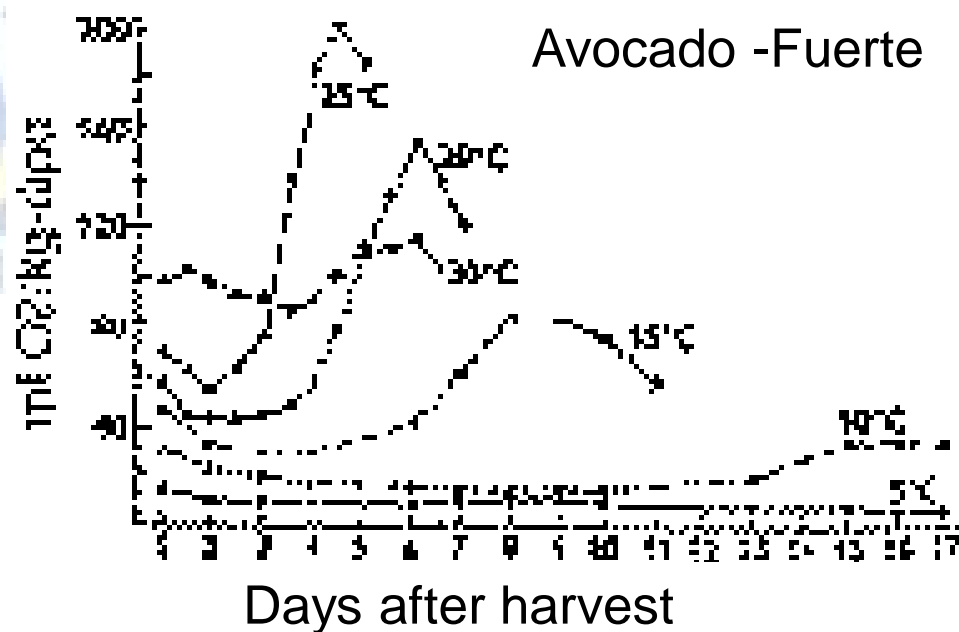
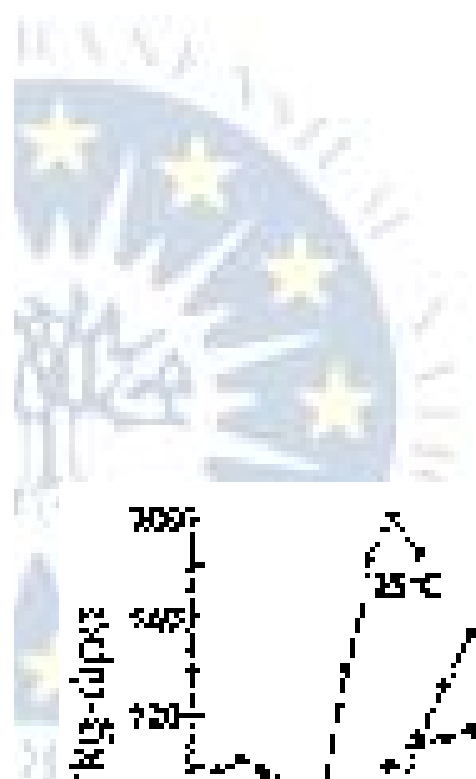
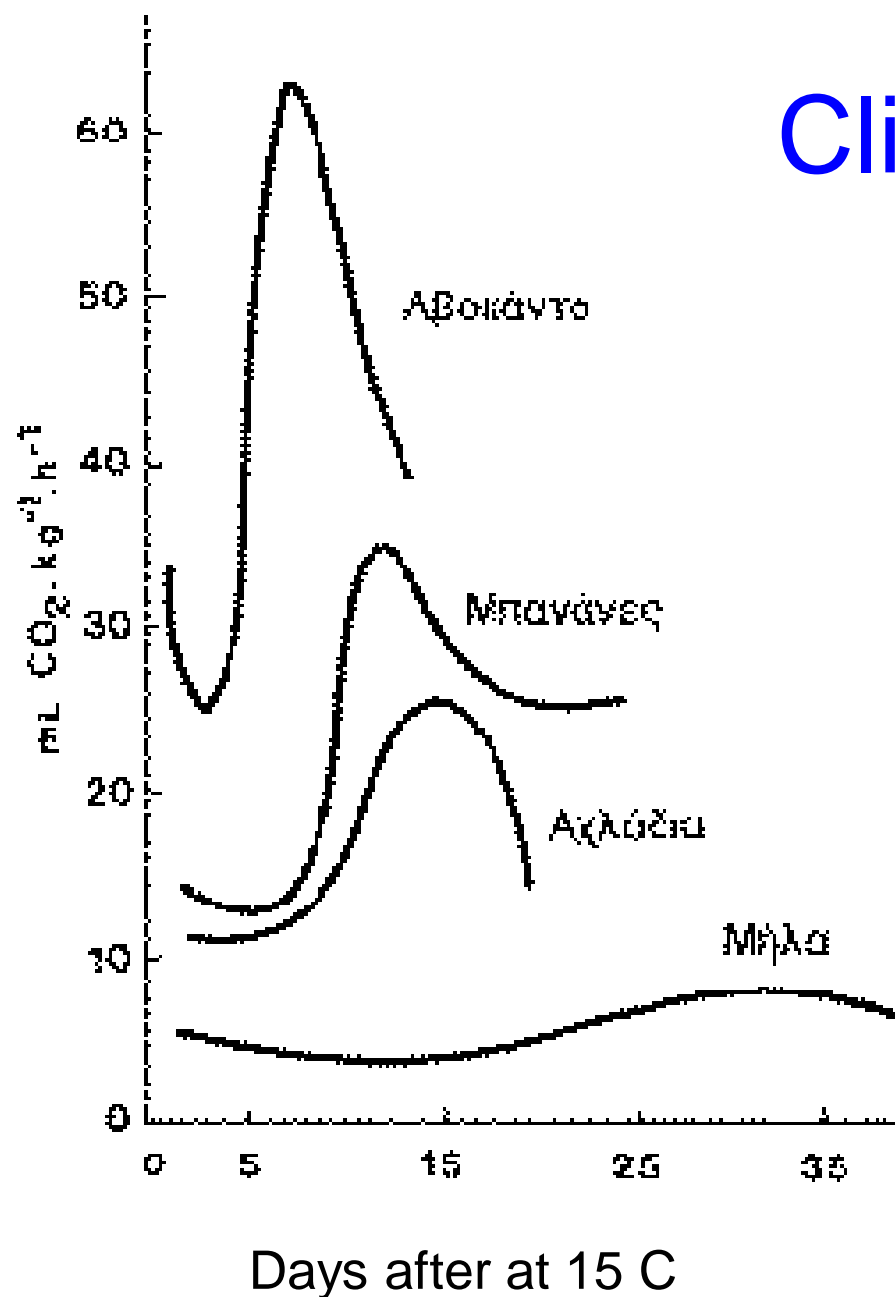


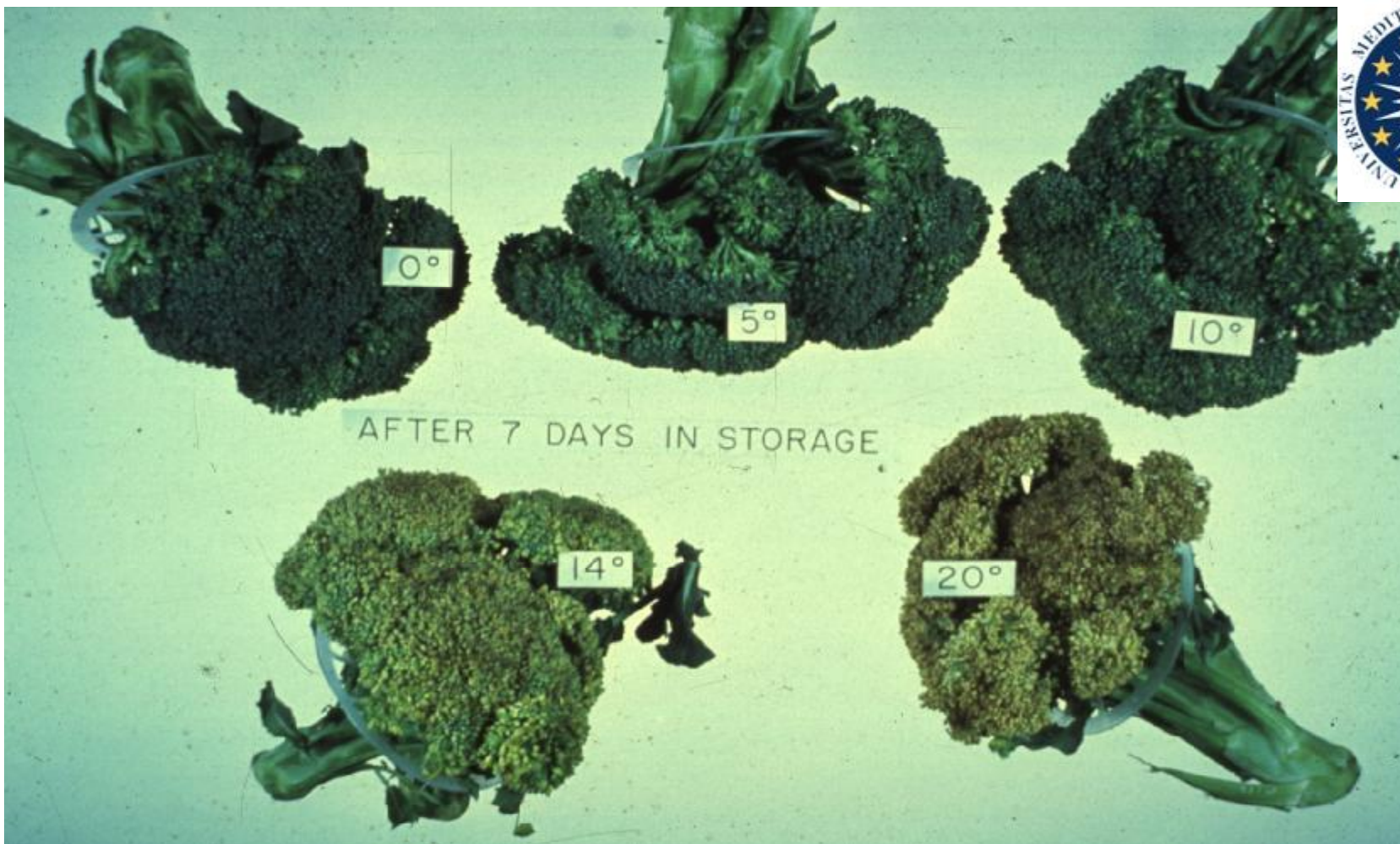
Environmental factors influencing deterioration

- Temperature
- Relative humidity
- Atmospheric composition
- Ethylene
- Light
- Other factors (pesticides, growth regulators e.t.)



Climacteric fruits





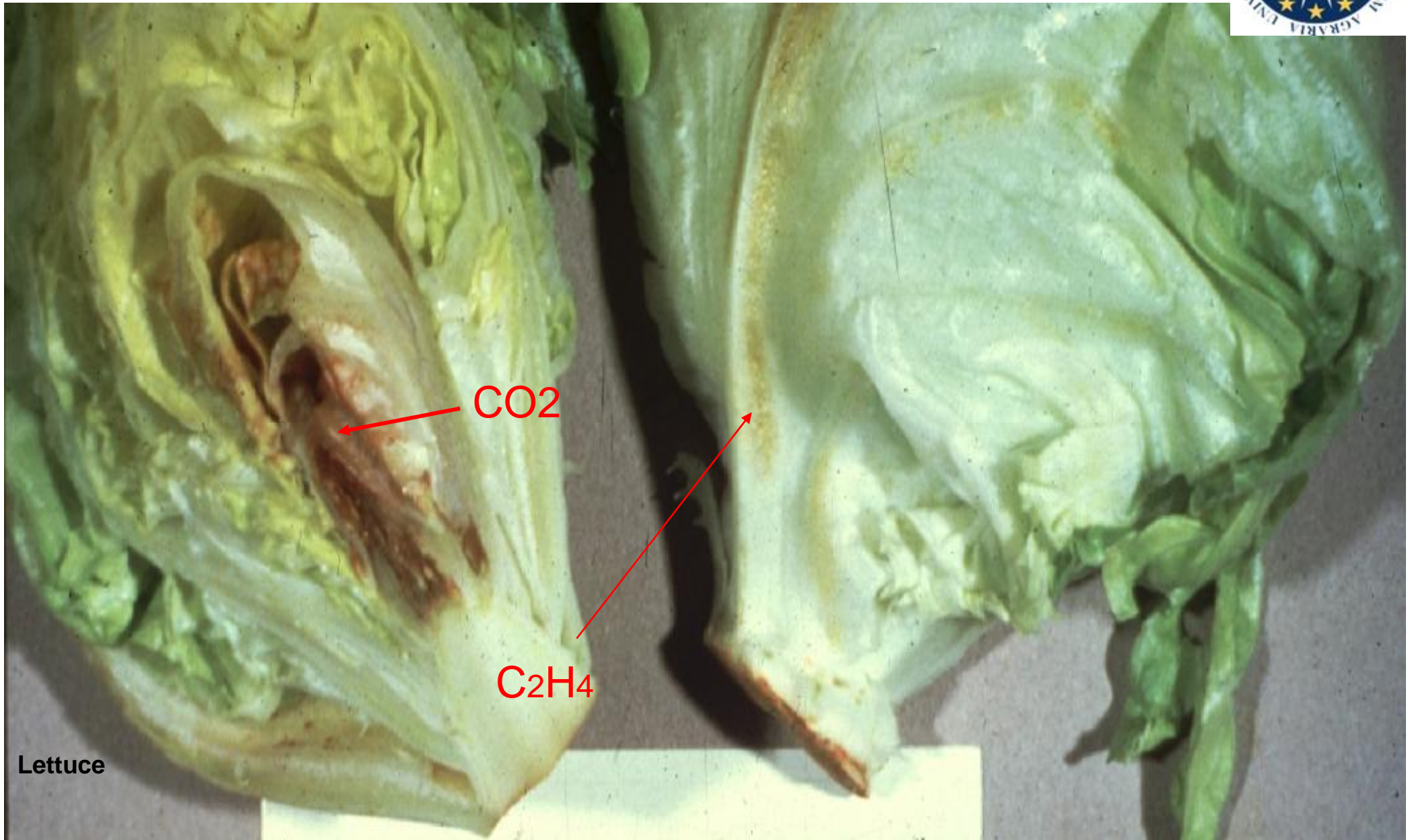
Temperature	Assumed	Relative velocity	Relative	Loss per
ÆC	Q10	of deterioration	shelflife	day (%)
0		1	100	1
10	3	3	33	3
20	2.5	7.5	13	8
30	2	15	7	14
40	1.5	22.5	4	25

Relative humidity



Atmospheric composition

$\text{CO}_2/\text{C}_2\text{H}_4$ effects on quality

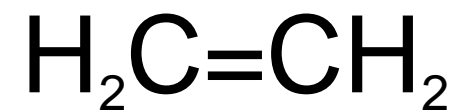


Lettuce

Ethylene effects on quality

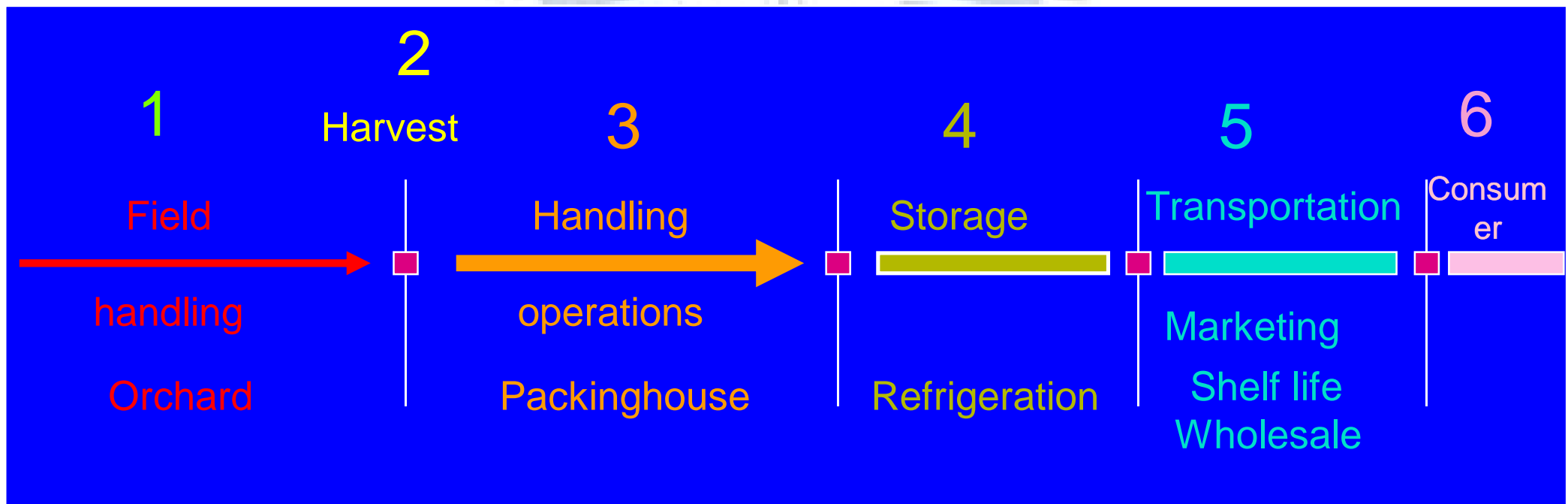


Ethylene



Where postharvest losses are significant?

- Harvesting-packaging
- Preservation-storage
- Distribution-transportation (wholesale, retail)
- Consumer





Postharvest losses of fruits and vegetables

25% in industrialised countries

50% in developing countries

Due to the lack of storage facilities

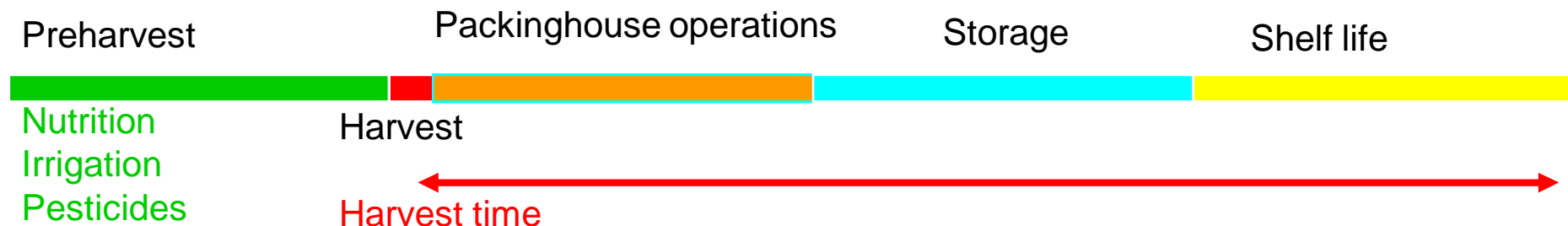
Perishable products: spoilage from fungal attacks

- high water content
- wounds

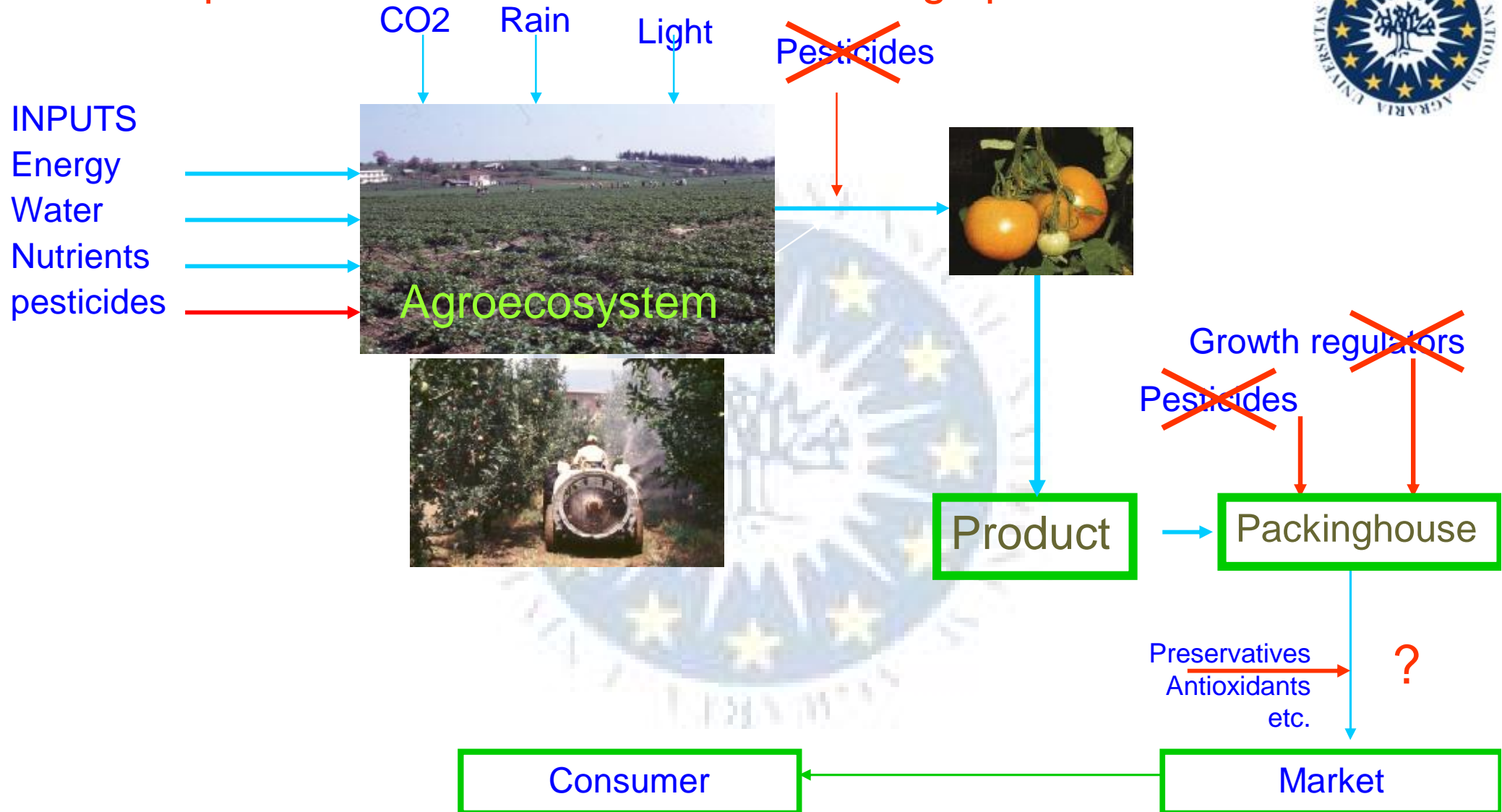


Reduction of postharvest losses

- Preharvest factors
- Harvesting and field handling
- Curing
- Postharvest handling during storage and transportation
 - Temperature management
 - Control of relative humidity(RH)
- Supplements to temperature and RH
- Chemical treatments



Inputs of chemicals in conventional agr. production



The spoilage of horticultural commodities may be caused by reactions (related with **quality** and **safety**)

- physical
- chemical
- enzymatic
- Pathogenic (bacteria, fungus)

Goals of the postharvest technology to prevent:

- *** **Quality spoilage**
- *** **Pathological spoilage**

Quality spoilage

Reducing postharvest losses

Postharvest technology techniques by:

- **Temperature** management procedures
- Control of **relative humidity** (avoid water loss)
- **Atmospheric composition** (Controlled Atmosphere storage, Modified atmosphere packaging)
- **Chemical treatments** (control of physiological disorders)
- Removal of **ethylene** and other volatiles when needed
- **Supplements** to temperature control (curing, cleaning, sorting, waxing, heat treatments, ethylene treatments)
- **Biotechnology approach?**

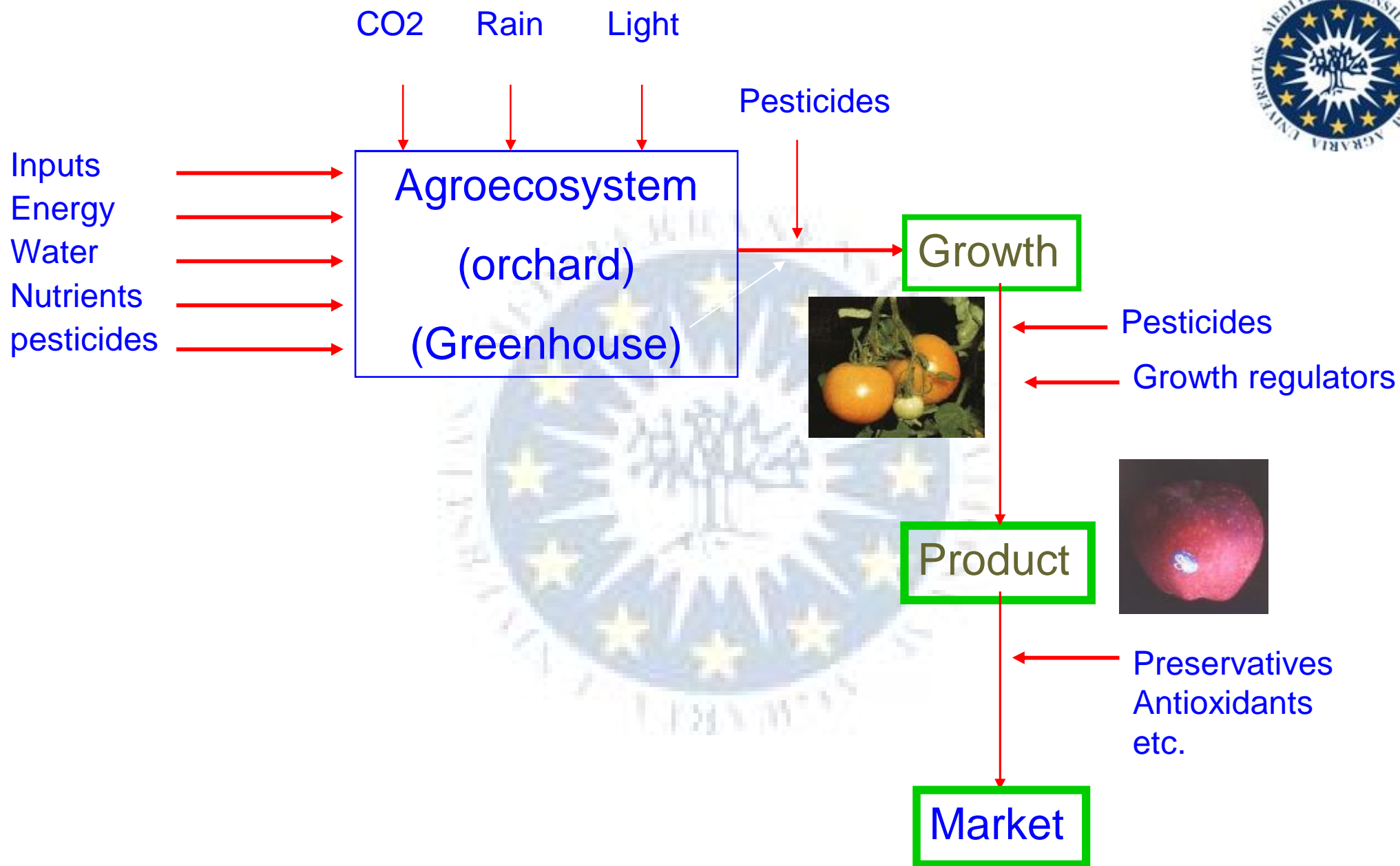


Control

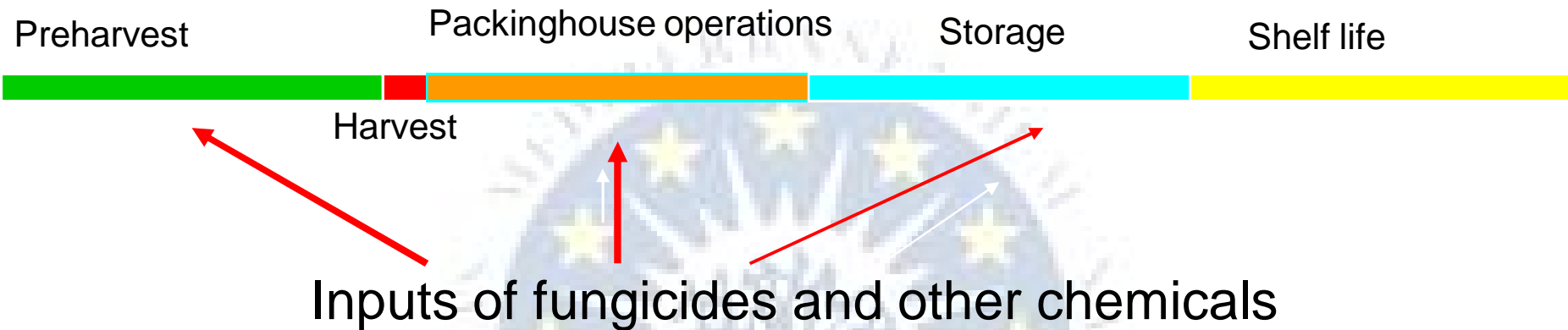
ULO 0,7% O₂

ULO 1%





Synthetic fungicides are the principal means to control PH diseases





Reducing postharvest losses

Problems

- The development of fungicide-resistant strains of PH pathogen
- Continues approval of fungicides
- The implementing the above techniques to control pathogens a possible damage to product quality
- Pesticide residues on the product

Search for alternative approaches?



New preservation methods of fresh horticultural products

Objectives of the course:

1. Alternative methods to control postharvest diseases
2. Biologically -based technologies
3. Natural volatiles
4. Thermal treatments
5. Modified atmosphere packaging
6. Edible films and coatings
7. Food preservation by hurdle technology
8. Postharvest physiology and technology of fresh-cut horticultural products



Student responsibilities and obligations:

I. Attendance of the lectures

II. Term paper assignment:

Write a short review paper (3-4 pages)

Sources of information related to the topic:

Lectures covered

Library resources

Internet access

Specific topic will be discussed in agreement with the student

III. Final exam: 5 pages

Student evaluation based on:

Final exam	70%
Term paper	20%
Attendance of the lectures	10%



Reading material (for the examination):

For each lecture one (review) article/lecture to read and the print out of the slide presentation

Assignment for each student:

a specific topic will be requested from each student for home work

Bibliography is included in the review articles

(if you need more information for specific problems more articles will be provided in pdf form -under request)

Also access to the internet site for the specific topic to find the most recent published work